Summary of the Fire Prevention and Material Flammability Working Group

Issue: Fire Scenarios for ISS/Shuttle

1.) Pressurized gaseous oxygen systems (up to 6000 psia) exist that are subject to numerous ignition mechanisms, including "flow friction," compression heating, particle impact, contamination/kindling chain reactions, mechanical impact, friction, etc.
2.) Solid Fuel Oxygen Generator (SFOG) since there have been two recorded fire events on Mir Program.
3.) Overheating of electrical cable (pyrolysis event) reasonably common (one event in ten missions)
4.) Electrical short due fire events on Apollo 204 and Apollo 13 or Foreign Object Debris.
5.) Work-arounds/mods especially in long duration mission.
6.) Aging wire or age/wear induced failures in electrical systems related to recent Shuttle Orbiter and SRB experiences.

*Note: Does not consider propulsion systems.

Research Areas:

1.) High Priority – Investigate ignition mechanisms and flammability for pressurized oxygen systems.

Outcome/Suggestions:

1.) Train crew on awareness and considerations for fire safety.
2.) Investigate potential for waste storage autoignition.
3.) Take advantage of lessons learned from AWIGG (Aircraft Wiring and Inert Gas Generator) working group.

Issue: Testing/Screening Methods

1.) Augment existing go/no go criteria with quantitative test method which provides ranking or indication of flammability margin, e.g. LOI or radiation panel (High)
2.) More understanding on relationship between 1G test methods to microgravity performance. (High)
3.) Need to understand the implications of non-flaming and smoldering combustion in microgravity with respect to ISS engineering materials. (High)
4.) Microgravity data for selected engineering materials to enable design analysis (includes effects of oxygen and flow on ignition, combustion and flame propagation). (High)
5.) Potential toxicity and fire hazards of pyrolysis of combustion products and aerosols may be a concern. (Moderate)

6.) Better understanding or data of partial gravity combustion behavior for exploratory missions is needed. (High)
7.) Establish a better understanding of relationship between flame spread across thermally thick and thin materials. (High)
8.) Need for long duration microgravity experimental data. (High)

Issue: New materials need to be studied

1.) Inflatable structures (Moderate)
2.) Flame retardant foams (High)
3.) Flame retardant fabrics or treatments (Moderate)
4.) Alternative wire insulation (High)
5.) Advanced composites (Moderate)

Issue: New research considerations

1.) Since future interplanetary missions will be weight limited, GN2 may be a limited resource, hence microgravity experiments at oxygen concentrations >30% should be considered.

Issue: ISRU processes and storage

1.) Education and training of researchers
2.) Understanding of hazards analysis techniques
3.) Improve understanding of flow friction as an ignition source (refer to item 1)
4.) Supplement particle impact database (refer to item 1)

Issue: Risk assessment

1.) Gain a better understanding of available probabilistic risk assessment and simulation tools.
2.) Understand what is done in the submarine industry.
3.) Confidence level considerations for repeatability of microgravity data/experiments.